1. UPPER CRETACEOUS POLLEN GRAINS FROM EGYPT II.

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Abstract

This contribution presents the taxonomy and the occurrences of the following form-genuses: *Cycadopites, Confertisulcites, Clavatipollenites, Liliacidites, Retimonocolpites, Echinoidites, Feugeuripollenites, Granamonocolpites, Psilamonocolpites, Monocolpopollenites, Farafrapollenites, Curvimonocolpites, Aegyptipollenites, Punctilongisulcites, Janducheneipollenites, Gemmazonocolpites, Trichotomosulcites* and *Saadipollenites*. New taxa described herein: *Auritomonosulcati* n. infraturma, *Farafrapollenites ellipsus* n. fgen. et fsp., *F. magnus* n. fsp., *Aegyptipollenites maastrichtiensis* n. fgen. et fsp., *Janducheneipollenites aegypticus* n. fgen. et fsp., *Saadipollenites farafraensis* n. fgen. et fsp., *S. maastrichtiensis* n. fsp., *Psilamonocolpites couperii* n. fsp., *Monocolpopollenites potoniei* n. fsp. *potoniei, M. potoniei* subfsp. *minor* n. subfsp., *Curvimonocolpites rakosii* n. fsp. *Trichotomosulcites couperii* n. fsp., *Retimonocolpites obaensis* subfsp. *aegypticus* n. subfsp., *Feugeuripollenites eocenicus* subfsp. *africanus* n. subfsp.

Key words: Palynology, fossil, *Gymnospermatophyta, Angiospermatophyta*, Upper Cretaceous, Egypt.

SUBTURMA: *MONOCOLPATES* IVERSEN and TROELS-SMITH 1950

Form-genus: *Cycadopites* WODEHOUSE 1933 ex WILSON and WEBSTER 1946

A new diagnosis was published by KRUTZSCH (1970), including a number of synonyms from 1933 through 1966.

1. *Cycadopites minor* (KEDVES 1961) KEDVES 1968, *Cycadaceae* v. *Spadiciflorae* (Plate 1.1., figs. 1,2)

Description: Monosulcate pollen grains with sharpened poles. Furrow asymmetrical, sometimes the exine is plicated parallel to the furrow. Surface scabrate. The exine is 0.3–0.6 μm thick, layered but the infratectal layer is not discernible by light microscope.

Polar axis: 23 μm; 22–29 μm.

Occurrence and frequency in the samples investigated from Egypt: Coniacian-Santonian: Abu Rauwash (70-1-7-1) infrequent, Abu Rauwash (70-1-7-2) infrequent, Duwi Common; Lower Campanian: Duwi frequent; Upper Campanian: Duwi infrequent; Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) common, Farafra (11) infrequent, Kharga (1-39) infrequent, Maestrichtian fm. indet.: Oweina (1) infrequent.

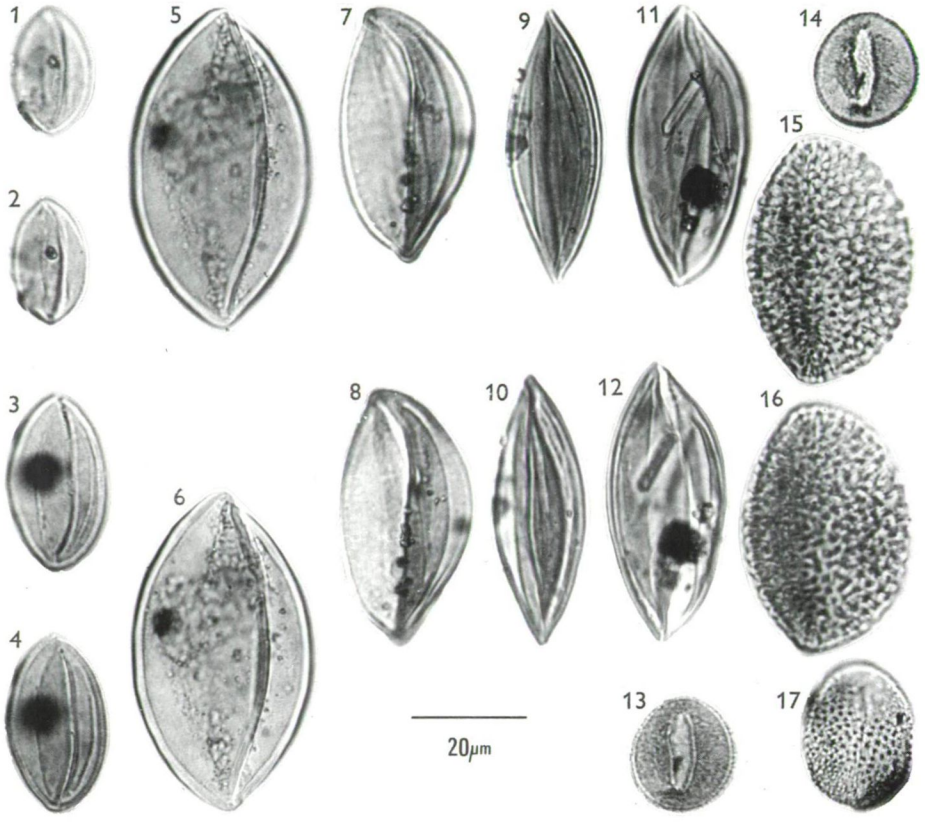

Plate 1.1.

1,2. *Cycadopites minor* (KEDVES 1961) KEDVES 1968, *Cycadaceae* v. *Spadiciflorae*, slide: Farafra-6-2-2-5, cross-table number: 12.2/105.2.

3,4. *Cycadopites fragilis* SINGH 1964, *Cycadaceae*, slide: Abu Minquar-4-3-10, cross-table number: 19.7/101.7.

5,6. *Cycadopites balinkaense* KEDVES 1974, *Cycadaceae, Encephalartos*, slide: Abu Minquar-4-3-9, cross-table number: 12.4/105.7.

7,8. *Cycadopites balinkaense* KEDVES 1974, *Cycadaceae, Encephalartos*, slide: Abu Minquar-4-3-4, cross-table number: 15.7/110.7.

9,10. *Confertisulcites fusiformis* FREDERIKSEN 1973, slide: Abu Minquar-4-3-1, cross-table number: 13.3/109.1.

11,12. *Confertisulcites fusiformis* FREDERIKSEN 1973, slide: Abu Minquar-4-3-4, cross-table number: 17.6/115.5.

13,14. *Clavatipollenites* cf. *rotundus* KEMP 1968, slide: Kharga-1-39-3, cross-table number: 11.1/111.2.

15,16. *Liliacidites barakatii* (HEGEDŰS, KEDVES and PÁRDUTZ 1972) KEDVES 1990, *Liliaceae*, slide: Farafra-6-2-2-1, cross-table number: 14.6/103.2.

17. *Liliacidites variegatus* COUPER 1953, *Liliaceae*, slide: Kharga-1-28-3, cross-table number: 10.1/119.5.

2. *Cycadopites fragilis* SINGH 1964, *Cycadaceae*
(Plate 1.1., figs. 3,4)

Description: Monosulcate pollen grains with slightly sharpened poles. Furrows asymmetrical with very characteristic plicae; sometimes resembling supplementary colpi. Surface scabrate-punctate. The exine is 1-1.2 μm thick, three layered; the three ectexine layers have the same thickness. The fine structure of the infratectal layer is not discernible by light microscope.

Polar axis: 30 μm; 27–38 μm.

Occurrence and frequency in the samples investigated from Egypt: Coniacian-Santonian: Abu Rauwash (70-1-7-1) infrequent, Maestrichtian, Nubia Sandstone: Farafra (6-2-1) infrequent, Abu Minquar (4-3) infrequent, Kharga (1-39) infrequent.

3. *Cycadopites balinkaense* KEDVES 1974, *Cycadaceae, Encephalartos*
(Plate 1.1., figs. 5–8)

Description: Monosulcate pollen grains with sharpened poles. Surface scabrate-punctate. The exine is 1.9–2.2 μm thick, three layered; the tectum is very thick, the infratectal layer is the thinnest; T/I/F = 4-5/1/1.5. Structure is probably alveolar but only small columella-like elements are observable.

Polar axis: 55 μm; 43–56 μm.

Remark: Generally, the exine is thicker and granular at the apices of the specimens of the Eocene layers of Hungary.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Abu Minquar (4-3) infrequent, Kharga (1-39) infrequent.

Form-genus: *Confertisulcites* ANDERSON 1960

These pollen grains are very similar to *Cycadopites*. The fusiform shape and the several plicae serve to distinguish these two form-genera.

1. *Confertisulcites fusiformis* FREDERIKSEN 1973
(Plate 1.1., figs. 9–12)

Description: Monosulcate pollen grains with generally characteristic sharpened poles. Around the furrow there are several plicae that are parallel with the ambitus. Surface smooth, or scabrate. The exine is 0.8–1.2 μm thick, the tectum, infratectal, and foot layer are equal. The fine structure of the infratectal layer is not discernible by the light microscope.

Polar axis: 48 μm; 42–50 μm.

Remark: *Monocolpopollenites banthelui* GRUAS-CAVAGNETTO 1968 is essentially this pollen type.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Abu Minquar (4-3) infrequent.

Form-genus: *Clavatipollenites* COUPER 1958

DOYLE, M. VAN CAMPO and LUGARDON (1975) discussed in detail the taxonomy of these pollen grains. The SEM study of *C.* cf. *hughesii* COUPER 1958 from a Susque-

hanna Aqueduct sample (Barremian or Aptian) demonstrated that the tectum is perforated or eureticulate. The sulcus membrane is covered with indistinct verrucate elements. A TEM study revealed that there is no endexine.

1. *Clavatipollenites* cf. *rotundus* KEMP 1968
(Plate 1.1., figs. 13,14)

Description: Amb circular or elliptical. Surface finely reticulate, the mesh of the reticuli is 0.4–0.6 µm. The exine is 1.5–1.7 µm thick, the foot layer is the thickest between the ectexine layers; T/I/F = 1/1.5/3. The elements of the infratectal layer are thickened at their ends (pilae). The sulcus is short and does not reach the poles.

Polar axis: 20 µm.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Kharga (1-39) infrequent, Kharga (1-28) infrequent.

Form-genus: *Liliacidites* COUPER 1953

COUPER (1953), p. 56: "Reticulum variable in size, clavate, baculate in optical section." KRUTZSCH (1970), p. 30: "Die, wie oben schon erwähnt, nicht leichte Abgrenzung von *Liliacidites* zu *Arecipites* läßt sich nur durchführen, wenn man nur die größeren und gröber reticulaten Vertreter, die in der Tat weniger von *Palmen* als vor allem von *Liliaceen* etc. stammen dürften, bei *Liliacidites* beläßt."

1. *Liliacidites barakatii* (HEGEDŰS, KEDVES and PÁRDUTZ 1972) KEDVES 1990, *Liliaceae*
(Plate 1.1., figs. 15,16)

Description: Monosulcate pollen grains with sharpened apices. Sculpture reticulate, the mesh of the reticuli is 1.5–2.3 µm. Muri width is 1.3–1.8 µm. The exine is 2.2–2.4 µm thick, the tectum is the thickest between the ectexine layers.

Polar axis: 43 µm; 33–46 µm.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) common, Farafra (6-2-1) frequent, Kharga (1-39) common, Kharga (1-28) common, Maestrichtian, fm. indet.: Oweina (1) infrequent.

2. *Liliacidites variegatus* COUPER 1953, *Liliaceae*
(Plate 1.1., fig. 17, plate 1.2., fig. 1)

Description: Monosulcate pollen grains, the sulcus does not reach the poles. Sculpture reticulate, the mesh of the reticuli is 1.5–2.8 µm. The exine is 0.8–1.2 µm thick, the tectum, infratectal layer and the foot layer are equal in thickness.

Polar axis: 26 µm; 23–31 µm.

Remark: Similar form. – FREDERIKSEN (1973), pl. 3, fig. 15,16; *Liliacidites tritus* FREDERIKSEN n. sp. This species seems to be heterogeneous in character. See below *Retimonocolpites noremi* JAN DU CHÊNE and ADEGOKE 1978.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) common, Farafra (11) infrequent, Kharga (1-39) infrequent, Kharga (1-28) infrequent.

Form-genus: *Retimonocolpites* PIERCE 1961

KRUTZSCH (1970), p. 28: "Unterscheidende Merkmale zu *Liliacidites* sind die Größe, die allgemeine Größe des Reticulums und dessen Differenzierung."

As regards the botanical affinities of these pollen grains it is necessary to take into consideration the results of EHLER and SCHILL (1973) on recent *Bromeliaceae* pollen grains. The following data are worth mentioning in respect to our data: *Tillandsia ixioides* GRISEB., *T. tenuifolia* L., *Dychia choristaminea* L. B. SMITH, *Navia crispa* L. B. SMITH.

1. *Retimonocolpites vaneendenburgi* (GERMERAAD, HOPPING and MULLER 1968) n. comb.
   (Plate 1.2., figs. 2–5)

Syn.: 1968 *Longapertites vaneendenburgi* GERMERAAD, HOPPING and MULLER, p. 298, pl. 5, fig. 4.

Description: Monosulcate pollen grains, with sharpened apices. Furrow asymmetrical and reaching the poles. Surface finely reticulate, the lumen and the muri width are generally equal; 0.5–0.8 µm. The amb of the lumen is polygonal. The exine is 0.5–0.7 µm thick, the infratectal layer is the thickest between the ectexine layers, T/I/F = 1/2/1.

Polar axis: 52 µm; 44–53 µm.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) infrequent.

2. *Retimonocolpites abeokutaensis* JAN DU CHÊNE 1977
   (Plate 1.2., figs. 6,7)

Description: Monosulcate pollen grains with ellipsoidal amb or with sharpened apices. Furrow asymmetrical, long but in general does not reach the apices. Surface finely reticulate, the mesh of the reticuli is 0.8–1.2 µm, the muri is 0.5 µm in width. Exine is 1–1.3 µm thick, the infratectal layer is the thickest between the ectexine layers, T/I/F = 1/1.5/1. The infratectal layer is columellar.

Polar axis: 38 µm; 32–40 µm.

Remarks: The specimens from Egypt are a little smaller than those of Senegal. The lumina of the reticulum of *R. splendidus* GONZÁLEZ GUZMÁN 1967 are larger 0.5–1 µm, and the polar axis is 49–55 µm.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) infrequent.

3. *Retimonocolpites obaensis* JAN DU CHÊNE, ONYIKE and SOWUNMI 1978 subfsp. *aegypticus* n. subfsp.
   (Plate 1.2., figs. 8–11)

Syn.: 1965 *Monocolpopollenites* sp., JARDINÉ and MAGLOIRE, p. 212, pl. 9, figs. 5–8; Campanian – L. Senonian, Ivory Coast; L. Senonian, Senegal.


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Plate 1.2.

Diagnosis: Monosulcate pollen grains, sulcus asymmetrical and does not reach the apices. Surface very finely reticulate, the mesh of the reticuli is 0.2–0.3 µm; muri width is 0.2 µm. The exine is 0.5–0.7 µm thick; the infratectal layer is a little thicker than the tectum and the foot layer, T/I/F = 1/1.5/1.

Polar axis: 31 µm; 26–35 µm.

Subfsp. type: Plate 1.2., figs. 8,9, slide: Farafra-6-2-2-1, cross-table number: 18.8/109.7.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Stratum typicum: clayey brown coal.

Derivatio nominis: From Egypt.

Differential diagnosis: *R. obaensis* JAN DU CHÊNE, ONYIKE and SOWUNMI 1978 *obaensis* is larger; 34–45 µm, diameter of the muri 0.5–0.7 µm, those of the lumen, 0.8–1.4 µm, the exine is 1.1–1.5 µm thick. *R. noremi* JAN DU CHÊNE and ADEGOKE 1978a is smaller (23 µm).

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) common, Farafra (6-2-1) frequent, Farafra (11) infrequent, Kharga (1-39) infrequent, Kharga (1-28) infrequent.

Plate 1.2.

1. *Liliacidites variegatus* COUPER 1953, *Liliaceae*, slide: Kharga-1-28-3, cross-table number: 10.1/119.5.
2,3. *Retimonocolpites vaneendenburgi* (GERMERAAD, HOPPING and MULLER 1968) n. comb., slide: Farafra-6-2-2-1, cross-table number: 8.3/115.8.
4,5. *Retimonocolpites vaneendenburgi* (GERMERAAD, HOPPING and MULLER 1968) n. comb., slide: Farafra-6-2-1-5, cross-table number: 19.0/106.2.
6,7. *Retimonocolpites abeokutaensis* JAN DU CHÊNE 1977, slide: Farafra-6-2-2-1, cross-table number: 13.6/101.4.
8,9. *Retimonocolpites obaensis* JAN DU CHÊNE, ONYIKE and SOWUNMI 1978 subfsp. *aegypticus* n. subfsp., slide: Farafra-6-2-2-1, cross-table number: 18.8/109.7.
10,11. *Retimonocolpites obaensis* JAN DU CHÊNE, ONYIKE and SOWUNMI 1978 subfsp. *aegypticus* n. subfsp., slide: Farafra-6-2-2-1, cross-table number: 8.1/109.7.
12,13. *Retimonocolpites noremi* JAN DU CHÊNE and ADEGOKE 1978a, cf. *Palmae*, slide: Farafra-6-2-2-3, cross-table number: 16.8/112.6.
14,15. *Retimonocolpites noremi* JAN DU CHÊNE and ADEGOKE 1978a, cf. *Palmae*, slide: Farafra-6-2-1-7, cross-table number: 3.8/111.8.
16,17. *Echinoidites* fsp., slide: Farafra-6-2-2-10, cross-table number: 13.4/102.9.
18,19. *Feugueuripollenites eocenicus* (KEDVES 1965) KEDVES 1968 subfsp. *africanus* n. subfsp., *Palmae*, slide: Farafra-6-2-1-5, cross-table number: 11.6/107.7.
20,21. *Feugueripollenites eocenicus* (KEDVES 1965) KEDVES 1968 subfsp. *africanus* n. subfsp., *Palmae*, slide: Farafra-6-2-1-5, cross-table number: 11.6/107.7.
22,23. *Granamonocolpites* fsp., *Palmae*, slide: Farafra-6-2-2-1, cross-table number: 17.6/102.3.
24,25. *Psilamonocolpites couperii* n. fsp., *Palmae*, slide: Kharga-1-39-4, cross-table number: 13.6/108.4.
26,27. *Monocolpopollenites potoniei* n. fsp. subfsp. *potoniei*, slide: Farafra-6-2-2-5, cross-table number: 9.2/115.8.
28,29. *Monocolpopollenites potoniei* n. fsp. subfsp. *potoniei*, slide: Farafra-6-2-2-4, cross-table number: 12.3/108.3.
30,31. *Monocolpopollenites potoniei* n. fsp. subfsp. *minor* n. subfsp., slide: Farafra-6-2-2-11, cross-table number: 17.7/106.5.
32,33. *Farafrapollenites ellipsus* n. fgen. et fsp., slide: Farafra-6-2-1-4, cross-table number: 5.3/104.2.
34,35. *Farafrapollenites ellipsus* n. fgen. et fsp., slide: Farafra-6-2-1-6, cross-table number: 4.1/109.7.
36,37. *Farafrapollenites magnus* n. fgen. et fsp., slide: Farafra-6-2-1-10, cross-table number: 14.7/103.4.
38. *Curvimonocolpites rakosii* n. fsp., slide: Abu Minquar-4-3-4, cross-table number: 10.3/113.4.

4. *Retimonocolpites noremi* JAN DU CHÊNE and ADEGOKE 1978a, cf. *Palmae*
(Plate 1.2., figs. 12–15)

Description: Monosulcate pollen grains with sharpened apices. Sulcus, in general asymmetrical, and reaching the poles. Surface finely reticulate, the mesh of the reticuli is 0.2–0.3 µm, the muri are 0.2 µm in width. The exine is 0.7–1 µm thick, T/I/F = 1.5/2/1.

Polar axis: 25 µm; 22–29 µm.

Remarks: The specimens from Egypt are a little larger than those specimens from the Paleocene layers of Nigeria. *Liliacidites tritus* FREDERIKSEN 1973 (Pl. 3, figs. 13,14) is similar.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) infrequent, Abu Minquar (4-3) infrequent, Kharga (1-39) common, Kharga (1-28) common.

Form-genus: *Echinoidites* GONZÁLEZ GUZMÁN 1967

This form-genus was described from the Eocene layers of Colombia. The echinate sculptural elements are sometimes slightly clavate. Therefore there is a certain similarity with the *Grimsdalea* types of JAN DU CHÊNE, ONYIKE and SOWUNMI (1978) from the Eocene layers of Nigeria. However *Grimsdalea* GERMERAAD, HOPPING and MULLER 1968 from Trinidad is a non-aperturate pollen type.

1. *Echinoidites* fsp.
(Plate 1.2., figs. 16,17)

Description: Surface smooth the exine is 0.5–0.8 µm thick, the infratectal layer is a little thicker than the tectum and the foot layer. Structure finely baculate. The sculptural elements are 8–12 µm long, sometimes slightly thickened at their ends so this sculpture is similar to those of *Grimsdalea* GERMERAAD, HOPPING and MULLER 1968, but the pollen grains of the later mentioned form-genus are inaperturate.

Polar axis: 49 µm; smaller that the specimen of GONZÁLEZ GUZMÁN (1967).

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent.

Form-genus: *Feugueuripollenites* KEDVES 1968

Relatively small monosulcate pollen grains, ornamented with short spinae.

1. *Feugueuripollenites eocenicus* (KEDVES 1965) KEDVES 1968 subfsp. *africanus* n. subfsp.
(Plate 1.2., figs. 18–21)

Diagnosis: Monosulcate pollen grain, sulcus asymmetric and reach the poles. Surface smooth to scabrate, sculptured with echinate sculptural elements which are 2–2.6 µm long. The exine is 0.5–0.6 µm thick, the infratectal layer is a little thicker than the tectum and the foot layer, T/I/F = 1/1.5/1.

Polar axis: 23 µm; 19–24 µm.

Subfsp. type: Plate 1.2., figs. 18,19, slide: Farafra-6-2-1-5, cross-table number: 11.6/107.7.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Stratum typicum: clay.

Derivatio nominis: From Africa.

Differential diagnosis: *F. eocenicus* (KEDVES 1965) KEDVES 1968 *eocenicus* is larger (20–38 μm) and the exine is 1.5–2 μm thick. The sculptural elements are 1–2 μm long.

Remarks: Recent taxa, with similar pollen grains: *Astelis cunninghamii* HOOK (COUPER, 1960, pl. 9, fig. 8), *Didymosperma porphyrocarpa* WENDL. (KEDVES, 1980, Plate 4, figs. 2,3).

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) common, Farafra (6-2-1) common, Farafra (11) infrequent.

Form-genus: *Granamonocolpites* PIERCE 1961

Monosulcate pollen grains, sculpture granulate.

1. *Granamonocolpites* fsp., *Palmae*
   (Plate 1.2., figs. 22,23)

Description: Monosulcate pollen grains with sharpened apices. The sulcus is long and reaches the poles. The surface is granulate, sometimes the sculptural elements anastomosent to rugulate ornamentation. Size of the ornamental elements is 0.4–1.5 μm. The exine is 0.5–0.7 μm thick, the infratectal layer is a little thicker than the tectum and the foot layer, T/I/F = 1/1.5/1.

Polar axis: 23 μm; 32–48 μm.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Kharga (1-39) infrequent.

Form-genus: *Psilamonocolpites* VAN DER HAMMEN and GARCIA MUTIS 1965

Psilate, monocolpate pollen grains.

Psilamonocolpites MATHUR 1966, p. 40, pl. 1, fig. 15 is junior homonym of *Ps.* VAN DER HAMMEN and GARCIA MUTIS 1965, cf. JANSONIUS and HILLS, 2224.

1. *Psilamonocolpites couperii* n. fsp.
   (Plate 1.2., figs. 24,25)

Diagnosis: Monosulcate pollen grains, the sulcus is asymmetrical, long, but do not reach the poles. Surface smooth. The exine is 0.6–0.9 μm thick, the tectum, infratectal layer and the foot layer are of equal thickness. Structure finely intrabaculate.

Polar axis: 20 μm; 18–23 μm.

Holotype: Plate 1.2., figs. 24,25, slide: Kharga-1-39-4, cross-table number: 13.6/108.4.

Locus typicus: Kharga, Maestrichtian, Nubia Sandstone.

Stratum typicum: clay.

Derivatio nominis: In honour of Dr. R. A. COUPER.

Differential diagnosis: *Psilamonocolpites* (= *Monosulcites*) *otagoensis* COUPER 1960 is larger, and the exine is 1.5–2 μm thick.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Kharga (1-39) infrequent.

Form-genus: *Monocolpopollenites* PFLUG 1953, in THOMSON and PFLUG 1953

A number of species were closed in this form-genus, but it is necessary to emphasize that the sulcus of this genus does not reach the poles (cf. the original paper of R. POTONIÉ 1934, and KRUTZSCH 1970). The pollen grains of *Rectosulcites* ANDERSON 1960 have broad and relatively short furrows, but these furrows are newer broader at their ends, as opposed to those of *Monocolpopollenites*. The pollen grain of JAN DU CHÊNE, DE KLASZ and ARCHIBONG (1978) from the Cretaceous layers of Senegal (pl. 3, fig. 12) belongs to this form-genus. Similarly *Psilamonocolpites minor* JAN DU CHÊNE and ADEGOKE 1978b (in JAN DU CHÊNE, ADEGOKE, ADEDIRAN and PETTERS) from the Maestrichtian of Nigeria also belongs to this genus.

1.1. *Monocolpopollenites potoniei* n. fsp. subfsp. *potoniei*
(Plate 1.2., figs. 26–29)

Diagnosis: Amb circular or elliptical. Surface scabrate-punctate. The exine is 0.4–0.5 µm thick, its structure is not discernible by the light microscope. Sulcus is in general asymmetric and does not reach the poles. Around the sulcus margin there are exine thick rings. The sulcus is 0.8–1.2 µm wide in the middle and 2.5–5 µm at their ends.

Polar axis: 16 µm; 16–25 µm.

Holotype: Plate 1.2., figs. 26,27, slide: Farafra-6-2-2-5, cross-table number: 9.2/115.8.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Stratum typicum: clayey brown coal.

Derivatio nominis: In memoriam of Prof. Dr. R. POTONIÉ, who first described this morphological type of palm pollen grain from the pre-Quaternary sediments.

Differential diagnosis: The ambitus, the very thin pollen wall and the peculiar sulcus morphology distinguish this species from *M. tranquillus* (R. POTONIÉ 1934) THOMSON and PFLUG 1953, see the emended diagnosis of NICHOLS, AMES and TRAVERSE (1973), p. 251, *M. tranquilloides* NICHOLS, AMES and TRAVERSE 1973 is larger and the ambitus is more elongated than that of *M. potoniei*.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) common, Farafra (6-2-1) infrequent, Farafra (11) infrequent.

1.2. *Monocolpopollenites potoniei* n. fsp. subfsp. *minor* n. subfsp.
(Plate 1.2., figs. 30,31)

Diagnosis: Amb generally elliptical. The sulcus is 0.7–1.3 µm wide in the middle and 1.5–3 µm at the ends.

Diameter: 12 µm; 10–14 µm.

Subfsp. type: Plate 1.2., figs. 30,31, slide: Farafra-6-2-2-11, cross-table number: 17.7/106.5.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Stratum typicum: clayey brown coal.

Derivatio nominis: From its smaller size.

Differential diagnosis: The smaller size distinguish it from the typical forms of this form-species.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (11) infrequent.

Form-genus: *Farafrapollenites* n. fgen.
Form-genus type: *Farafrapollenites ellipsus* n. fgen. et fsp.
(Plate 1.2., figs. 32–35)

Diagnosis: Monosulcate pollen grains, the sulcus does not reach the poles and are narrower in the middle that at the ends. Around the sulcus, the exine is characteristically sculptured – verrucate, sometimes rugulate. The extra-apertural exine is smooth or scabrate.

Form-genus type: Plate 1.2., figs. 32,33, slide: Farafra-6-2-1-4, cross-table number: 5.3/104.2.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Stratum typicum: clay.

Derivatio nominis: From Farafra, from the locality type.

Differential diagnosis: The sculptured sulcus margin clearly separates this genus from *Monocolpopollenites* PFLUG 1953.

Remarks: *Clavatipollenites incisus* KHLOVONA 1976 has a similar sculptured zone around the sulcus, but its sculpture separates it from the described new form-genus. On the other hand it seems that KHLONOVA's (1976) species is quite different from the earlier described species of *Clavatipollenites* COUPER 1958.

1. *Farafrapollenites ellipsus* n. fsp.
(Plate 1.2., figs. 32–35)

Diagnosis: Amb ellipsoidal, surface scabrate. The exine is 0.5–0.8 μm thick, the tectum, infratectum, and the foot layer are of equal thickness. The fine structure of the infratectal layer is not discernible by optical microscope. The sulcus is long but does not reach the poles. Around the sulcus the verrucae are 1–1.5 μm in basal diameter, sometimes anastomosent. The sulcus is 2–3.5 μm wide at the ends.

Polar axis: 20 μm; 18–24 μm.

Holotype, locus typicus, stratum typicum, see previously.

Derivatio nominis: From the form of the ambitus.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) common.

2. *Farafrapollenites magnus* n. fsp.
(Plate 1.2., figs. 36,37)

Diagnosis: Amb circular or elliptical. Surface smooth or scabrate. The exine is 0.6–0.8 μm thick, the three layers of the ectexine are of equal thickness. The fine structure of the infratectal layer is not discernible by light microscope, probably granular. The sulcus is long but does not reach the poles; the widening at the ends is 1.2–1.5 μm. Around the sulcus, the sculptured zone is 2.5–4.5 μm wide, granulate-verrucate, the ornamental elements have 1–1.5 μm basal diameter.

Polar axis: 28 μm; 26–32 μm.

Holotype: Plate 1.2., figs. 36,37, slide: Farafra-6-2-1-10, cross-table number: 14.7/103.4.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.
Stratum typicum: clay.
Derivatio nominis: From its relatively large size.
Differential diagnosis: The larger size, the moderately hollowed sulcus and the larger sculptured zone around the sulcus separate this species from *F. ellipsus* n. fgen. et fsp.
Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) common.

Form-genus: *Curvimonocolpites* LEIDELMEYER 1966 here emended.

Emended diagnosis: Asymmetrical, monosulcate pollen grains. Surface psilate, scabrate, finely sculptured or perforated. The aperture is along the concave side of the pollen grain.
Remarks: The data of L. RÁKOSI (1973, 1977) from the Eocene layers of Hungary (*C. inornatus* LEIDELM. 1966) is worth mentioning.

1. *Curvimonocolpites rakosii* n. fsp.
(Plate 1.2., fig. 38, plate 1.3., figs. 1–3)

Diagnosis: Amb characteristic asymmetrical, half ellipse. Surface finely perforated, the diameter of the perforations is about 0.2 μm. Inter-apertural exine is 0.4–0.6 μm thick, its structure is not discernible by optical microscope. Near the sulcus the exine is 1–1.5 μm thick with characteristic structure, the tectum, infratectum, and the foot layer are equal in thickness. Structure finely intrabaculate.
Polar axis: 42 μm; 33–46 μm.
Holotype: Plate 1.2., fig. 38, plate 1.3., fig. 1, slide: Abu Minquar-4-3-4; cross-table number: 10.3/113.4.
Locus typicus: Abu Minquar, Maestrichtian, Nubia Sandstone.
Stratum typicum: coaly clay.
Derivatio nominis: In honour of Dr. L. RÁKOSI, excellent investigator of the Lower Tertiary sporomorphs.
Differential diagnosis: The perforate tectum of *C. rakosii* n. fsp. serves to clearly separate it from *C. inornatus* LEIDELM. 1966, which has a psilate to scabrate, imperforate tectum.
Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Abu Minquar (4-3) infrequent.

Form-genus: *Aegyptipollenites* n. fgen.
Form-genus type: *Aegyptipollenites maastrichtiensis* n. fgen. et fsp.
(Plate 1.3., figs. 4–7)

Diagnosis: Monocolpate pollen grains with equatorial circular band. Surface smooth or finely sculptured; the colpal margin is generally ornamented with characteristic sculptural elements.
Form-genus type: Plate 1.3., figs. 4,5, slide: Abu Minquar-4-3-7, cross-table number: 16.2/104.9.
Locus typicus: Abu Minquar, Maestrichtian, Nubia Sandstone.
Stratum typicum: coaly clay.
Derivatio nominis: From Egypt.

Differential diagnosis: The lack of medial horns distinguished this genus from *Galeacornea* STOVER 1963.

Remarks: The new genus may be an evolved form of the Middle Cretaceous "*Galeacornea* type" microfossils.

1. *Aegyptipollenites maastrichtiensis* n. fsp.
   (Plate 1.3., figs. 4–7)

Syn: 1995 *Proxapertites africanus* KDS. nom. nud., JELEN, KEDVES, SKABERNE, BREZIGAR, BUSER, CIMERMAN, DROBNE, MONOSTORI, PAVLOVEC and PAVŠIČ, p. 22, plate 2.3., figs. 13, 14.

Diagnosis: Amb elliptical, sometimes with slightly sharpened apices. The colpus reach the apices, the sculpture of the colpal margin is verrucate or rugulate, the size of the ornamental elements is 1.5–2.2 μm. Near the colpus, the exine is granulate, the extra-apertural exine is smooth or scabrate and 2–3 μm thick; in the germinal region there is characteristic intrabaculate structure; T/I/F = 2/1/2. The extra-apertural exine is 1 μm thick generally, and its structure is not clearly discernible by light microscope. The equatorial circular band is 3–5 μm thick, its exine is also thick.

Diameter: 36 μm; 28–40 μm.

Holotype, locus typicus, stratum typicum see previously.

Derivatio nominis: From its geological age.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Abu Minquar (4-3) common.

Form-genus: *Punctilongisulcites* KRUTZSCH 1970

Longisulcate pollen grains, surface punctate, granulate, finely echinate or verrucate.

1. *Punctilongisulcites* fsp.
   (Plate 1.3., figs. 8,9)

Description: Amb ellipsoidal. Sculpture echinate, the sculptural elements are 1–1.2 μm long, and thickened at their base. Exine is 0.6–0.8 μm, the infratectal layer is a little thicker than the outer and the inner ectexine layer. Structure is not well discernible by light microscope; probably infrabaculate. The sulcus is long, on the shorter side is 1/3 of the polar axis.

Polar axis: 28 μm.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-1) infrequent.

Form-genus: *Janducheneipollenites* n. fgen.

Form-genus type: *Janducheneipollenites aegypticus* n. fgen. et fsp.
(Plate 1.3., figs. 10–15)

Diagnosis: Zonosulcate pollen grains, surface smooth or scabrate. Around the sulcus there is a zone with ornamental elements, but this is a pseudosculpture as a result of the tectum reduction. This is similar to granular or verrucate ornamentation.

Form-genus type: Plate 1.3., figs. 10,11, slide: Farafra-6-2-2-8, cross-table number: 12.5/116.3.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Stratum typicum: clayey brown coal.

Derivatio nominis: In honour of Dr. R. JAN DU CHÊNE, excellent investigator of the fossil sporomorphs of Africa.

Differential diagnosis: The new genus is separated from *Gemmazonocolpites* JAN DU CHÊNE 1977 by the pseudosculptured zone around the sulcus. The form-genus described by JAN DU CHÊNE (1977) has a gemmate sculpture around the germinal area.

1. *Janducheneipollenites aegypticus* n. fsp.
   (Plate 1.3., figs. 10–15)

Diagnosis: Amb ellipsoidal. Surface scabrate. The exine is 0.6–0.8 μm thick, the tectum, infratectum and the foot layer are of equal thickness, T/I/F = 1/1/1. The structure is not clearly discernible by optical microscope. The pseudosculptured zone around the furrow is 4–6 μm, the elements are 0.5 μm in diameter and its form is globular.

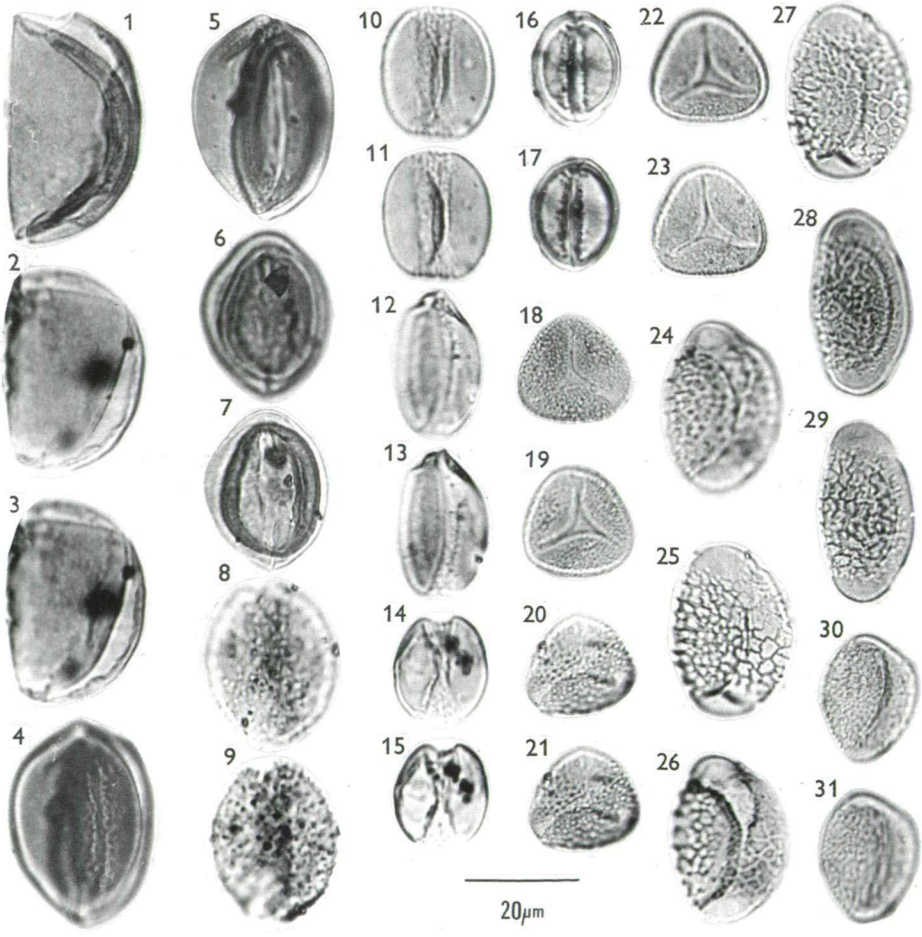

Plate 1.3.

Diameter: 21 µm; 18–27 µm.

Holotype, locus typicus, stratum typicum see at the fgen. diagnosis.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) infrequent, Farafra (11) infrequent, Kharga (1-39) infrequent.

Form-genus: *Gemmazonocolpites* JAN DU CHÊNE 1977

Diagnosis – JANSONIUS and HILLS, 3466: "Pollen grain with one encircling equatorial sulcus, with a scabrate sculpture except a large band with gemmae. This band seems to cover the equatorial sulcus."

1. *Gemmazonocolpites spheroidites* (JARDINÉ and MAGLOIRE 1965) n. comb. (Plate 1.3., figs. 16,17)

Syn.: 1965 *Monocolpopollenites spheroidites* JARDINÉ and MAGLOIRE, p. 211, 212, pl. 8, figs. 27–30.

Description: Zonosulcate pollen grains. Surface scabrate. The exine is 2–3 µm thick, the nexine is the thickest between the exine layers; T/I/N = 1/1/3-4. The structure is finely intrabaculate. Around the sulcus it is about 1–1.5 µm wide thickening and its margin is ornamented with globular elements, 0.5–1 µm in diameter.

Polar axis: 20 µm.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-1) infrequent.

SUBTURMA: *TRICHOTOMOSULCATES* ERDTMAN 1945

Plate 1.3.

1. *Curvimonocolpites rakosii* n. fsp., slide: Abu Minquar-4-3-4, cross-table number: 10.3/113.4.
2,3. *Curvimonocolpites rakosii* n. fsp., slide: Abu Minquar-4-3-3, cross-table number: 5.0/105.6.
4,5. *Aegyptipollenites maastrichtiensis* n. fgen. et fsp., slide: Abu Minquar-4-3-7, cross-table number: 16.2/104.9.
6,7. *Aegyptipollenites maastrichtiensis* n. fgen. et fsp., slide: Abu Minquar-4-3-7, cross-table number: 5.6/107.2.
8,9. *Punctilongisculcites* fsp., slide: Farafra-6-2-1-9, cross-table number: 9.6/116.6.
10,11. *Janducheneipollenites aegypticus* n. fgen. et fsp., slide: Farafra-6-2-2-8, cross-table number: 12.5/116.3.
12,13. *Janducheneipollenites aegypticus* n. fgen. et fsp., slide: Farafra-6-2-1-6, cross-table number: 3.7/107.2.
14,15. *Janducheneipollenites aegypticus* n. fgen. et fsp., slide: Farafra-6-2-2-8, cross-table number: 9.1/106.2.
16,17. *Gemmazonocolpites sphaeroidites* (JARDINÉ and MAGLOIRE 1965) n. comb., slide: Farafra-6-2-1-8, cross-table number: 6.4/115.6.
18,19. *Trichotomosulcites couperii* n. fsp., *Palmae*, slide: Farafra-6-2-2-1, cross-table number: 8.4/105.5.
20,21. *Trichotomosulcites couperii* n. fsp., *Palmae*, slide: Farafra-6-2-2-1, cross-table number: 19.8/115.8.
22,23. *Trichotomosulcites couperii* n. fsp., *Palmae*, slide: Farafra-6-2-2-1, cross-table number: 13.8/104.1.
24,25. *Saadipollenites farafraensis* n. fgen. et fsp., slide: Farafra-11-1, cross-table number: 11.2/112.8.
26,27. *Saadipollenites farafraensis* n. fgen. et fsp., slide: Farafra-6-2-2-1, cross-table number: 5.6/113.1.
28,29. *Saadipollenites farafraensis* n. fgen. et fsp., slide: Farafra-6-2-2-1, cross-table number: 9.3/116.4.
30,31. *Saadipollenites maastrichtiensis* n. fgen. et fsp., slide: Farafra-6-2-2-1, cross-table number: 13.7/116.9.

Form-genus: *Trichotomosulcites* ERDTMAN 1945 ex COUPER 1953

The trichotomosulcate feature is definitive and characteristic for this genus. However it must be emphasized that, based on the results of a study of recent *palm* pollen grains, there are several species which exhibit both monosulcate and trichotomosulcate forms. Sometimes this is a characteristic feature of a species. Therefore this form-genus is somewhat problematical.

1. *Trichotomosulcites couperii* n. fsp.
   (Plate 1.3., figs. 18–23)

Diagnosis: Trichotomosulcate pollen grains, the branches of the sulcus do not reach the equator. Sculpture reticulate, the mesh of the reticuli is 0.3–0.6 μm, muri width, 0.3–0.4 μm. The exine is 0.7 μm thick, the infratectum is thicker than the tectum or the foot layer, T/I/F = 1/1.5/1.

Diameter: 20 μm; 17–23 μm.

Holotype: Plate 1.3., figs. 18,19, slide: Farafra-6-2-2-1, cross-table number: 8.4/105.5.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Stratum typicum: clayey brown coal.

Derivatio nominis: In honour of Dr. R. A. COUPER excellent investigator of the pre-Quaternary sporomorphs.

Differential diagnosis: *T. subgranulatus* COUPER 1953 is finely granular – psilate, size: 27–35 μm. *T. waronuiensis* COUPER 1953 is sub-verrucate, size: 31–35 μm. *T. antiquus* KRUTZSCH and LENK 1969 is reticulate–foveolate, lumina of the reticulum are 0.5–2 μm, size: 32–36 μm. In this way the larger size clearly separates it from *T. couperii* n. fsp. *T. ornatus* BOLTENHAGEN 1976, form the Senonian of Gabon, is reticulate. The mesh of the reticulum is 0.5–5 μm. The large lumina of the reticulum are a very good feature for distinction. The surface of *T. laevigatus* BOLTENHAGEN 1976 is smooth.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) common, Farafra (6-2-1) infrequent.

INFRATURMA: *AURITOMONOSULCATI* n. infraturma

Monosulcate pollen grains, with sculptured, generally reticulate surface. The poles are finely or unsculptured, or with appendices.

Form-genus: *Saadipollenites* n. fgen.

Form-genus type: *Saadipollenites farafraensis* n. fgen. et fsp.
(Plate 1.3., figs. 24–29)

Diagnosis: Monosulcate pollen grains, the surface reticulate. The apices are smooth and rounded, forming a pseudoauricula, its wall consists only of a foot layer.

Form-genus type: Plate 1.3., figs. 24,25, slide: Farafra-11-1, cross-table number: 11.2/112.8.

Stratum typicum: clay.

Derivatio nominis: In honour of Prof. Dr. S. I. SAAD, pioneer of palynological researches in Egypt.

Differential diagnosis: This form-genus must be compared with the monosulcate, auriculate pollen grains. The form-genus *Auriculiidites* was described by ELSIK (1964) from the Upper Cretaceous (Campanian) Vivian Formation of Peru. BELSKY, BOLTENHAGEN and POTONIÉ (1965) published the new genus *Pediculisporis* from the Upper Cretaceous, probably Santonian layers, of Gabon. Later, BOLTENHAGEN (1967) established the fact that *Pediculisporis* is synonymous with *Auriculiidites*, and he emended this latter mentioned genus. ELSIK and THANIKAIMONI (1970) emended the form-genus *Auriculiidites* and compared *Auriculiidites reticulatus* with *Bomarea lyncina* HERB. (*Amaryllidaceae*). ELSIK (1973) described *A. paleocenicus* from Alaska, associated with *Aquilapollenites* and *Pistillipollenites*. ELSIK (1974) reviewed the knowledge of the fossil auriculate pollen grains and introduced the form-genus *Chlonovaia*, which is tricolpate, auriculate; the form-genus type was described by KHLONOVA (1966) as *Auriculiidites sibiricus*. The validation of *Chlonovaia* was published later by ELSIK (1976). Concerning *Auriculiidites* (ELSIK 1964) ELSIK and THANIKAIMONI 1970, the following comments were published: ELSIK 1974, p. 525: "Includes fossil monosulcate, reticulate pollen with "filled" auriculae in contrast to *Pediculisporis*, which has hollow auriculae." In comparison with the described new form-genus we emphasize the following: *Chlonovaia* is tricolporate, the bases of the auriculae of *Pediculisporis* are narrow (never found in our specimens), and the "filled" auriculae of *Auriculiidites* separates it from *Saadipollenites* n. fgen. There is some morphological similarity of our new form-genus with *Liliacidites inaequalis* SINGH 1971, from the Lower Cretaceous layers of Alberta, but the apices of these pollen grains are not smooth.

1. *Saadipollenites farafraensis* n. fsp.
   (Plate 1.3., figs. 24–29)

Diagnosis: Monosulcate pollen grains, the sulcus asymmetric. Sculpture reticulate; in the middle of the pollen grain the mesh of the reticuli is 3–5 µm; on the border of the sculptured part and the pseudo-auricula is 0.3–0.4 µm. Muri width about 0.4–0.6 µm. The exine is 0.6–0.8 µm thick, the three ectexine layers are of identical thickness. The sulcus margin is smooth, in the middle of the pollen it is 2.5–3 µm and 0.5 µm wide near the apices. The smooth apex (pseudo-auricula) is 3–5 µm high, and 8–12 µm wide.

Polar axis: 30 µm; 23–32 µm.

Holotype, locus typicus, stratum typicum see previously.

Derivatio nominis: From Farafra.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) common, Farafra (6-2-1) infrequent, Farafra (11) infrequent.

2. *Saadipollenites maastrichtiensis* n. fsp.
   (Plate 1.3., figs. 30,31)

Diagnosis: Monosulcate, reticulate pollen grains. The mesh of the reticuli is 0.6–1.1 µm, muri width 0.4 µm. The exine is 0.5–0.7 µm thick, the three ectexine layers are of the same thickness. The smooth colpus margin is 1.2–1.6 µm wide. The smooth apex is 2–3 µm high, and 5–7 µm wide.

Polar axis: 22 µm; 20–28 µm.

Holotype: Plate 1.3., figs. 30,31, slide: Farafra-6-2-2-1, cross-table number: 13.7/116.9.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Stratum typicum: clayey brown coal.

Derivatio nominis: From the geological age of the holotype.

Differential diagnosis: The finer reticulate sculpture separates well this species from *S. farafraensis* n. fsp. It is a certain similarity with *Auriculiidites palaeocenicus* ELSIK 1973, but as it was emphasized previously, *Auriculiidites* have "filled" auriculae (ELSIK, 1974).

Remark. – The slides are deposited in the Cell Biological and Evolutionary Micropaleontological Laboratory of the Dept. of Botany of the J. A. University, Szeged, Hungary.

To be continued

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